Evaluation of Noise Effects in Auditory Function in Spanish Military Pilots

JM Lorente, B. Puente, B. Esteban, F. Ríos, P. Vallejo, C. Velasco
CIMA
Arturo Soria 82
28027 Madrid
SPAIN

E-mail: beapues@telefonica.net

INTRODUCTION

Military pilots are particularly exposed to a wide variety of environmental trends and one of them is the noise produce by the aircraft used for flying duties. In addition to that changes in cabin pressure and vibration can be considered as contributing factors.

Adverse effects can be produced under several situations, by self exposing to the noise environment in the flight line or during taxi, take off and cruise operations (1,2,3). Environmental stress can be partially coped by using noise reduction devices, but effectiveness is still far away from procuring a complete protection and devices are still problematic in various aspects (4).

Consequently limited effectiveness of speech communication and eventually hearing impairment or loss can be produced.

OBJECTIVES

From and epidemiological perspective we want to know the incidence of noise-induced hearing loss in a aleatory sample of aircrew members belonging to the Spanish Armed Forces in order to obtain valuable data and to proceed with eventual solutions and application of corrective measures that will lead to stop adverse effects of noise.

MATERIAL AND METHODS

Population studied in this work are aircrew members, all of them pilots of the Spanish Armed Forces. All pilots reviewed has been estudied in the Spanish Armed Forces Aeromedical Center (CIMA) (departments of Aerospace Medicine and ENT).

Samples were randomized among the pilots who currently take his annual physical check up.

Selected criteria were: to be fighter, transport or helicopter pilot and to be fit for that.

The study was anonimous, volonteer and written consent should be completed.

We rule out from the study all pilots with demonstrated ear disease or trauma detected during the physical.

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We stablished three phases in the design:

- Sociodemographic data: age and sex
- Aeronautical data: Service, type of aircraft, flying time, mean time of time flying period, type of hearing protection currently used (ear plugs, headsets or integrated helmet).
- ENT data:
  - ENT history, otitis, barotitis, hipoacusia, other aditional data.
  - ENT Exam: general, otoscopy, impedianciometry and audiometry.

Data were included in a data base for statistical analysis by using the SPSS (Statistical Package Social Sciences) version 10.0 for windows.

We perform descriptive study for the variables and we used the Kolmogrov-Smirnov Test for normal deviation of quantitative variables.

For mean deviation we used the Kruskall-Wallis and "u" of Mann-Whitey, depending on the characteristics of the variables; and Chi2 for comparison of proportions.

We considered for statistical analysis a significance of $p<0.05$.

RESULTS

A total of 372 pilots were studied, all of them males and mean age of 34, 74 (SD 7.97) and range between 23 and 56 years old.

A total of 276 were Air Force (AF) pilots (74.2%), 91 (24.5%) belongs to Army and 5 to the Navy (1.3%).

Table 1: Shows the Percentage of Pilots According to the Type of Aircraft and Mean Flying Time.

	Frequency	Valid Percent	Mean Flying Time
Fighter	82	22,0 %	2617,57
Transport	170	45,7 %	2785,03
Helicopters	120	32,3 %	1540,3
Total	372	100,0 %	

In order to analyse the outcome of the audiometry performed to each pilot, we have divided the sample in 4 age groups:

- 20-29 yo
- 30-39 yo
- 40-49 yo, and
- 50-59 yo

Table 2: Shows the Percentage of Pilots Distributed by Age Group.

Age Group	Frequency	Valid Percent
20-29	120	32.3 %
30-39	162	43.5 %
40-49	62	16.7 %
50-59	28	7.5 %
Total	372	100.0 %

To correlate the results of the audiometries we took into account the physiological loss by age group and in every frequency (250. 500, 1000, 2000, 4000, 8000 Hz) according to the modified T J Leisti (5) tables (Table 4), depicted in Figure 1.

Table 4: Physiological Loss According to T.J. Leisti.

Age	125	250	500	1000	2000	4000	8000
20-29	0	0	0	0	0	3	5
30-39	5	5	5	5	6	14	16
40-49	7	7	7	8	8	21	25
50-59	10	10	12	12	13	29	32
60-69	14	14	15	19	24	40	48
70-79	18	19	23	24	31	47	59
80	22	23	27	33	39	56	66

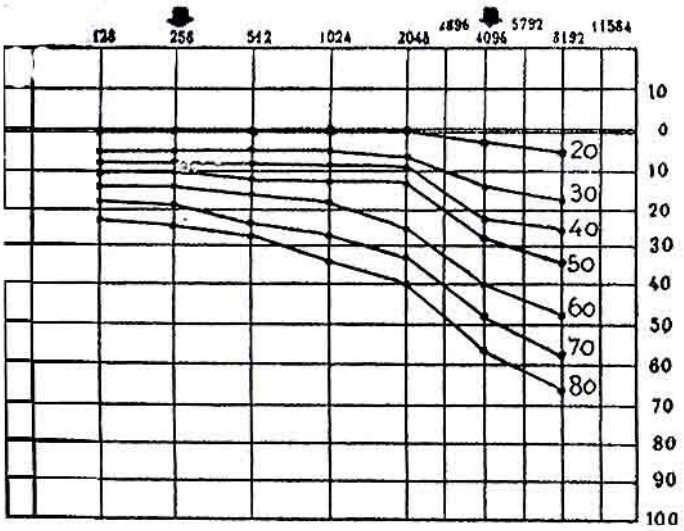


Figure 1: Shows Age Loss Depicted by Leisti.

Tables 5, 6 and 7: Shows the Findings According to Type of Aircraft.

Table 5

	FIGHTER PILOTS			
FREQUENCY	RIGHT EAR		LEFT EAR	
	NORMAL	ANORMAL	NORMAL	ANORMAL
250	45,1%	54.9%	51.2%	48.8%
500	50%	50%	59.8%	40.2%
1000	76.8%	23,2%	81.7%	18,3%
2000	76.8%	23.2%	73.2%	26.8%
4000	56.1%	43,9%	48.8%	51.2%
8000	58.5%	41,5%	56.1%	43.9%

Table 6

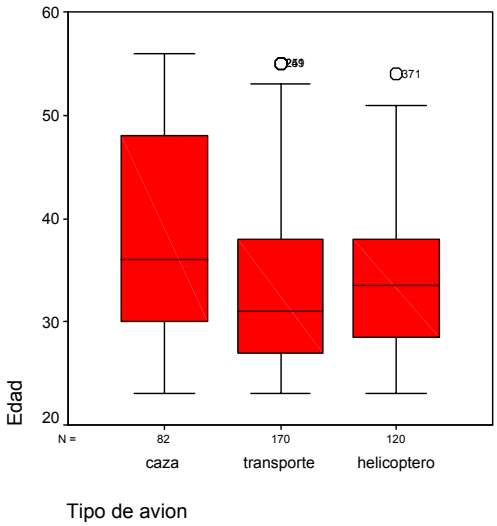
	TRANSPORT PILOTS			
FREQUENCY	RIGHT EAR		LEFT EAR	
	NORMAL	ABNORMAL	NORMAL	ABNORMAL
250	39.4%	60.6%	40.0%	60,0%
500	33.5%	66.5%	35.3%	64.7%
1000	73.5%	26.5%	68.2%	31.8%
2000	80.0%	20.0%	73.5%	26.5%
4000	58.8%	41.2%	52.9%	47.1%
8000	65.9%	34.1%	62.9%	37,1%

Table 7

	HELICOPTER PILOTS			
FREQUENCY	RIGHT EAR		LEFT EAR	
	NORMAL	ABNORMAL	NORMAL	ABNORMAL
250	45.0%	55.0%	41.7%	58.3%
500	37.5%	62.5%	41.7%	58.3%
1000	72.5%	27.5%	75.8%	24.2%
2000	74.2%	25.8%	78.2%	21.8%
4000	63.3%	36.7%	55.0%	45.0%
8000	70.0%	30.0%	69.2%	30.8%

Results coming from the comparative study of groups (Fighter vs Transport) in each frequency, shows that fighter pilots got a better audiometry with statistical significance (p=0.012) in the frequencies of 500 for the Right Ear. In the Left Ear p<0.000 at 500 and p<0.025 at 1000. There are no differences between transport and helicopters.

In order to evaluate if age could be considered as a causal factor we crossed age with type of aircraft and results showed that after application of Mann-Whitney U Test, the fighter pilots got an age statistical significant older than transport and helicopter pilots (p=0.000 and p=0.002), Figure 2 depicted those differences.



Regarding Ear Protection we found that 91.4% of fighter pilots used integrated helmet, but only 4.3% of transport and 57.5% of helicopters pilots currently used integrated helmet. Statistical difference were found with p=0.000.

DISCUSSION

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Hearing loss due to exposure to aviation environment is extensively presented in the current literature. Many authors correlate noise, loss in auditory perception and exposure to noise related to aviation (2, 6, 7, 8, 9, 10, 11, 12, 13, 14). Mechanisms of ear impairment involved are: repeated barotraumas which affect the middle ear leading to low frequencies impairment, and exposure to environmental aviation noise (aircraft engine noise, etc…) which lead to impairment in frequencies of 3000 and 4000.

In this paper we have demonstrated how often we observed audio impairment in military pilots. Only 16.1% (60 pilots out of a total of 372) does not show any impairment.

Helicopter and transport pilots use to be the more noise induce impaired. In acute frequencies (500) in both ears and frequency of 1000 in the left ear, the fighter pilot got a better ear acuity.

Age is not a factor, in spite of the type of aircraft, even older pilots but better protected meant a better ear acuity. Apparently the transport pilots and helicopter pilots seems to be less protected or to receive a pour protection, and actually we demonstrated that with a good degree of statistical significance.

CONCLUSIONS

1. High incidence of audio impairment in military pilots.
2. More impairment in transport and helicopter pilots.
3. Frequencies more affected in our study: 500 Hz and 1000 Hz.
4. Age is not a factor in this study.
5. Transport and helicopter pilots are insufficiently protected.
6. Barotraumas should be consider as a contributing factor.
7. Low frequency vibrations should be consider as well as contributing hactor.

So, hearing loss in pilots should be considered as a professional disease and linked to noise production, repeated barotraumas and (low frequency) vibrations; the lack of adequate hearing protection can lead to loss, and prevention is a key factor in stopping auditory impairment and the only way to cope such problem.

Epidemiological studies must pursue a better understanding of the incidence, factors related and countermeasures establishment.

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